International Standard

ISO 15664

Acoustics — Noise control design procedures for open plant

Acoustique — Modes opératoires de contrôle du bruit dans les installations ouvertes

Second edition
2025-12

Reference number
ISO 15664:2025(en)

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Published in Switzerland

Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **2**
3.1 General terms 2
3.2 Terms specific to noise 2
4 General requirements **5**
5 General noise limits (immission requirements) **6**
5.1 In-plant noise 6
5.1.1 General 6
5.1.2 Emergency area noise limit 6
5.1.3 Work area noise limit 6
5.1.4 Restricted area 6
5.1.5 Modification/extension of an existing plant 7
5.2 Environmental noise 7
5.3 Exceptional or infrequent operating conditions 7
5.4 Additional restrictions for tonal or impulsive noise 7
6 Equipment noise limits (emission requirements) **8**
6.1 General 8
6.1.1 Default equipment noise limits 8
6.1.2 Noise control measures 8
6.2 Equipment emitting noise to external environment 9
6.3 Equipment emitting intermittent or fluctuating noise 9
6.4 Equipment located outside the work area 9
6.5 Additional restrictions for tonal or impulsive noise 9
6.6 Equipment noise data sheets 9
6.6.1 Noise limits 10
6.6.2 Noise acceptance testing 10
6.6.3 Noise guarantees 10
6.7 Equipment selection 10
6.7.1 Bid comparison 10
7 Noise abatement **11**
7.1 Silencers 11
7.2 Acoustic enclosures 11
7.3 Sound absorption 11
8 Project control **11**
8.1 Noise control documentation 11
8.2 Engineering phase reports 12
8.3 Equipment noise test 12
8.4 Plant noise acceptance test 12
8.5 Remedial action 13
Annex A (normative) **Requirements on equipment suppliers for reporting and testing on noise** **14**
Annex B (informative) **Noise control flowchart** **16**
Annex C (informative) **Summary of action items and allocation of responsibility** **17**
Annex D (informative) **Noise aspects of specific equipment** **19**
Annex E (informative) **Example of equipment noise data sheet** **21**
Annex F (informative) **Documents to be made available to the noise control engineers** **22**

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Annex G (informative) **Example of format for the noise allocation report** **24**
Annex H (informative) **Example of format for the noise control report** **25**
Annex I (informative) **Example of format for the noise verification report** **26**
Bibliography **28**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This second edition cancels and replaces the first edition (ISO 15664:2001), which has been technically revised.

The main changes are as follows:

— The scope of this document has been updated to reflect that requirements for suppliers of noise-emitting equipment have been defined.

— Supplementary specification to this document as defined in S-717 by the Joint Industry Programme 33 (JIP33) of the International Association of Oil and Gas Producers (IOGP) has been added in a new annex (see Annex A).

— The equipment noise data sheet (see Annex E) has been updated.

— A recommended area noise limit has been included to be used where area noise limits are not defined elsewhere.

— Clause 6 has been updated to reflect changes in acoustic engineering work practises and the use of computational noise modelling tools.

— Annex C from the first edition was deleted and replaced by a new Annex C.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Achieving acceptable environmental and occupational noise conditions requires procedures for the noise control design of open plants. This is a common challenge in oil refineries, chemical plants, gas plants, onshore and offshore oil and gas production facilities, unenclosed powerplants, steelworks, gravel washing plants, cement plants, concrete batch plants, sawmills and other continuous, batch or intermittent operation plants located in the open.

The users of this document should be familiar with the type of plant involved and have sufficient technical expertise and experience in industrial plant noise control design. This document is intended to be flexible to suit the nature and location of the plant being designed, and the technical abilities of the parties involved.

It is specifically intended that the end-user and the contractor agree on the nature and extent of the work to be done, the reporting on the work, and which party carries out what work.

This document is not intended specifically to be a contract document, except for Annex A which is considered suitable for procurement specifications of individual equipment.

A list of standards related to this document is given in the Bibliography.

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Acoustics — Noise control design procedures for open plant

1 Scope

This document defines the procedures for noise control of primarily open plants and the requirements on equipment suppliers for reporting and testing of noise.

It is applicable to the following:

— specification of procedures for noise control during engineering of a new plant and modification/extension of existing plants (construction and commissioning noise procedures are outside the scope of this document);

— definition of responsibilities of parties involved, viz. “end-user”, “engineering contractor” and “equipment supplier”;

— description of general procedures to arrive at noise requirements for individual equipment, based on overall noise requirements for the plant.

Input to purchase specifications is presented in Annex A.

A schematic flowchart, reviewing the noise control process, is presented in Annex B and a summary of action items is presented in Annex C.

An example of an equipment noise data sheet is presented in Annex E.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI S12.12, *Method for the determination of sound power levels of noise sources using sound intensity*

ISO 1996-2:2017, *Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of sound pressure levels*

ISO 3741, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for reverberation test rooms*

ISO 3743 (all parts), *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for small, movable sources in reverberant fields*

ISO 3744, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3745, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms*

ISO 3746, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 3747, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment*

ISO 3864, *Safety colours and safety signs*

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ISO/TS 7849-2, *Acoustics — Determination of airborne sound power levels emitted by machinery using vibration measurement — Part 2: Engineering method including determination of the adequate radiation factor*

ISO 9614 (all parts), *Acoustics — Determination of sound power levels of noise sources using sound intensity*

ISO/TS 20065, *Acoustics — Objective method for assessing the audibility of tones in noise — Engineering method*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General terms

3.1.1
end-user
party which initiates the project and ultimately owns or operates the plant, or pays for its design and construction

Note 1 to entry: The end-user will generally specify the technical objectives and/or requirements.

3.1.2
contractor
party which carries out all or part of the design, engineering, procurement, construction and commissioning for the project

3.1.3
manufacturer
supplier
party which manufactures or supplies equipment and services to perform the duties specified by the *contractor* (3.1.2)

3.1.4
work area
any position not less than 1 m from equipment surfaces accessible to personnel, and any position where a worker's ear may be exposed to noise in the normal course of duty

Note 1 to entry: The work area also includes any platform, walkway or ladder.

3.1.5
project specification
document defining the scope of a project

Note 1 to entry: It can contain descriptions of the process, project management, responsibilities and engineering requirements. These include safety and environmental requirements.

3.1.6
regulatory authorities
local, regional, national, or other authorities that specify and enforce criteria for environmental and occupational health noise

3.2 Terms specific to noise

3.2.1
noise limit
noise levels not to be exceeded and given as a sound power level, sound pressure level, or noise exposure level

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3.2.1.1
regulatory noise limits
noise limits set by *regulatory authorities* (3.1.6)

3.2.1.3
contractual noise limits
noise limits set by the *end-user* (3.1.1) as part of a legal contract between the *end-user* (3.1.1) and the *contractor* (3.1.2), considering *regulatory noise limits* (3.2.1.1) and company requirements

3.2.1.4
area noise limits
noise limits set by the *end-user* (3.1.1) or *contractor* (3.1.2) for a *work area* (3.1.4) given as A-weighted equivalent continuous sound pressure level

3.2.1.5
equipment noise limits
noise limits set by an *end-user* (3.1.1) or *contractor* (3.1.2) for a *manufacturer/supplier* (3.1.3) for an individual equipment item

3.2.2
tonal noise
noise which is dominated by one or several clearly distinguishable tone(s)

Note 1 to entry: See ISO 1996-2 and ISO/TS 20065.

3.2.3
impulsive noise
sound characterized by brief bursts of sound pressure

Note 1 to entry: The duration of a single impulsive sound is usually less than 1 s. See ISO 1996-1 and ISO/PAS 1996-3.

3.2.4
fluctuating noise
noise whose level varies continuously and to an appreciable extent during the period of observation

[SOURCE: ISO 12001:1996, 3.19.1., modified — reference to figure deleted.]

3.2.5
intermittent noise
noise whose level abruptly drops to the level of the ambient noise several times during the period of observation. The time during which the level remains at a constant value clearly above that of the ambient".

[SOURCE: ISO 12001:2009, 3.19.2, modified — adjusted, so that only levels above the ambient are defined as intermittent noise.]

3.2.6
noise emission
airborne sound radiated by a well-defined noise source, such as a machine, equipment, part of a plant, or an entire plant

Note 1 to entry: See ISO 12001 and ISO 11690-1.

3.2.7
noise immission
total amount of noise from all contributing sources at a given receiver position

Note 1 to entry: See ISO 11690-1.

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3.2.8
noise exposure
all noises that arrive, over a specific time period, *T*, at a person's ear in the actual situation

Note 1 to entry: See ISO 11690-1; for the purposes of this document, this term is also used for specific positions in the environment.

[SOURCE: ISO 11690-1:2020, 3.3.2., modified — "of a person" deleted, reference to figures deleted.]

3.2.9
equivalent continuous sound pressure level
$L_{p,\mathrm{eq}T}$
ten times the logarithm to the base 10 of the ratio of the time-average of the square sound pressure, *p*, during a stated time interval of duration *T* (starting at t_1 and ending at t_2), to the square of a reference value, p_0, expressed in decibels

$$L_{p,T} = L_{p,\mathrm{eq}T} = 10\lg\left[\frac{\frac{1}{T}\int_{t_1}^{t_2} p^2(t)\,\mathrm{d}t}{p_0^2}\right]\mathrm{dB}$$

where the reference value, p_0 is 20 μPa

Note 1 to entry: Because of practical limitations of the measuring instruments, p^2 is always understood to denote the square of a frequency-weighted, frequency-band-limited or time-weighted sound pressure. If specific frequency and time weightings as specified in IEC 61672-1 and/or specific frequency bands are applied, this should be indicated by appropriate subscripts, e.g. $L_{p,AF}$ denotes the A-weighted sound pressure level with time weighting F.

Note 2 to entry: This definition is technically in accordance with ISO 80000-8:2007, 8-22.

[SOURCE: ISO/TR 25417:2007, 2.3]

3.2.10
sound pressure level
L_p
quantity given by:

$$L_p = 10\lg\frac{p_{\mathrm{RMS}}^2}{p_0^2}\mathrm{dB}$$

where p_{RMS} is the root-mean-square sound pressure in the time domain and p_0 is the reference value of sound pressure

[SOURCE: ISO 80000-8:2020, 8-14]

3.2.11
sound power level
L_W
quantity given by:

$$L_W = 10\lg\frac{P_m}{P_0}\mathrm{dB}$$

where P_m is the magnitude of the time-averaged sound power and P_0 is the reference value of sound power 1 pW

[SOURCE: ISO 80000-8:2020, 8-15]

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3.2.12
peak emission sound pressure level
$L_{p,\text{peak}}$
ten times the logarithm to the base 10 of the ratio of the square of the peak emission sound pressure, p_{peak}, to the square of a reference value, p_0, expressed in decibels

$$L_{p,\text{peak}} = 10\lg\frac{p_{\text{peak}}^2}{p_0^2}\,\text{dB}$$

where the reference value, p_0, is 20 µPa

Note 1 to entry: The peak emission sound pressure level is usually C-weighted and denoted $L_{pC,\text{peak}}$

[SOURCE: ISO 11204:2010, 3.5]

4 General requirements

The control of noise in a plant is necessary for the following reasons:

— to prevent noise-induced hearing loss;

— to reduce work, speech and concentration interference;

— to provide quiet living accommodation for personnel;

— to protect the environment;

— to prevent annoyance and adverse impact to the neighbouring community.

Noise limits can be given for each of the above aspects of noise control, relative to certain areas inside or outside the plant. For the purposes of this document, they are referred to as “general noise limits” and are specified in Clause 5.

Noise limits for each item of equipment shall be derived from the general noise limits, as applicable for the equipment in its specific position in the plant. These are commonly referred to as “equipment noise limits”. Procedures for deriving equipment noise limits are specified in Clause 6.

Each potential noise source shall be subject to the requirements of this document.

Recommendations for noise limits can be found in International Standards, e.g. ISO 11690-1 (workplace), ISO 9921 (speech communication) and ISO 1996 series (environment). Requirements for noise limits can also be provided by National Codes of Practice or statutory regulations or legislation.

The specified limits shall be met for the design operating conditions of the plant. They shall also hold for other operating conditions which occur occasionally, such as start-up, shutdown, regeneration, and maintenance, unless otherwise specified by the end-user and agreed upon with the contractor. In emergency situations (e.g. relief valve operation), a higher noise limit may be allowable, and the limit specified for such conditions shall not be exceeded.

This document deals with noise from more or less stationary equipment; however, noise radiated from mobile noise sources operating on the site, such as transportation vehicles (lorries, trucks, railway equipment) or mobile maintenance equipment in the plant or workshops, also needs to be considered. Noise due to mobile sources is more important if relatively high numbers of vehicles are present near the boundaries of the plant or if the plant is located near sensitive receivers. Regulatory authorities may also require consideration of noise emissions from mobile equipment. The end user and contractor shall agree whether or not this type of mobile source noise is to be considered as part of the noise control procedures.

The planning and scope of the noise control engineering for a plant is based heavily on the project specification. It is vital that all noise limits and any other noise requirements specified by the end-user be carefully and completely defined in the project specification. This is particularly true where more than one

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